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THE SUMMER CRANE-FLY FAUNA OF THE CUMBERLAND PLATEAU IN TENNESSEE

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THE present paper is the result of field studies and collections made in parts of Fentress, Morgan, and Scott counties, Tennessee. These counties lie in Northern Tennessee near the western boundary of Fenneman's Cumberland Plateau Section of the Appalachian Plateau Province.[2] A brief collecting trip was made to this region in late May of 1922, and in 1924 field work was carried on from June 6 to September 4. More than two-thirds of this time was spent in working intensively several restricted areas that are believed to have represented all of the principal types of crane-fly habitats. The rest of the time was given to widespread collecting over the three counties. In addition, I have a small collection of crane-flies taken by Professor T. H. Hubbell at Grassy Cove in Cumberland County, which bounds Fentress and Morgan counties on the south.

I wish to express here my gratitude to my brother, Rev. H. C. Rogers, and to Mr. M. Colditz, both of Allardt, Tennessee,

[1] Contribution from the Department of Biology of the University of Florida, Gainesville, Florida.

[2] Fenneman, N. W. 1916. Physiographic Divisions of the United States. Ann. Assoc. Amer. Geogr., vii: 19-98, 1 map.

for their hospitality and information. To Professor Hubbell, who was working on the Orthoptera of the same region, I owe the acknowledgment of helpful cooperation in the field and frequent discussion and comparison of field notes. He also made a collection of the more common plants of the region, and these were later identified by Father Hugh O'Neal of St. Leo, Florida. Finally, I am greatly indebted to Dr. C. P. Alexander of Massachusetts Agricultural College, specifically for his opinion as to the identity of several species (these are quoted in the annotated list), and in general for the continued encouragement and advice that he has cordially given since I first wrote to him concerning the crane-flies. All the undescribed species taken in Tennessee were sent to Dr. Alexander for description. His huge collection of tpyical material, and especially his unrivalled knowledge of the taxonomy of this group, made it seem better to forward undescribed species to him and concentrate my own interests on life histories and ecological distribution.

Description of the Region

The country within a radius of five or six miles of Allardt, Fentress County, is typical of most of the region, and a description of this area will include all but two or three of the main types of habitats. Allardt, with an altitude of 1670 feet,[3] is situated on a narrow divide between two tributaries of the Big South Fork of the Cumberland River. A few miles to the west, near the edge of the Cumberland Plateau, this divide meets the north and south divide between Big South Fork and the Obey River. Immediately about Allardt numerous small brooks and intermittent streams have made considerable relief, but in general the country along the divide is flat or but moderately undulating. The soil over most of this area is a light sandy loam, shading into the underlying Lee Conglomerate[4] at a depth of from three to four feet.

[3] The Wartburg (Tennessee) Folio. United States Geological Folios, No. 40.

[4] The Wartburg Folio.

Locally, in small areas of poor drainage, it is overlaid by black organic soil of slight to moderate depth.

According to Mr. M. Colditz, an early resident of Allardt, this upland region formerly bore an almost pure stand of open chestnut woods. Today it presents a patchwork of forest in various stages of over-cutting and second growth, wood pastures, cultivated fields, and stream-margin thickets, with sphagnum-huckleberry bogs, and gum, and alder swamps occurring about the heads of many of the small streams.

The present upland forest of the plateau and higher valley slopes is largely an oak-hickory, chestnut-chinquapin association with the areas of thinner soil dominated by short-leaf pine and black-jack oak.[5] Much of the forest floor is dry and poor in humus and leaf mould, and although dead wood is abundant, nearly all is in a dry condition. In the more mesophytic portions there is a considerable undergrowth of saplings and bushes and a well developed field stratum of annuals and grasses. Here there is a considerable accumulation of humus, and the dead wood often shows a wet or moist type of decay. Most of the wholly second growth areas consist of moderately thick stands of chinquapin and numerous species of oaks.

Associated with the small brooks and rills are a variety of distinctly moist or wet situations. A number of these stream courses are grown with thickets that are often extensive and range from almost pure stands of alder to associations of alder, red maple, black gum, sweet gum, and bamboo vine with a luxuriant growth of ferns beneath. Through these thickets the small streams wander in often-broken, indefinite channels; and the soil, subject to frequent overflow, varies from a coarse sand mixed with organic débris to a black sandy silt. Although frequently quite dry at the surface, the soil is saturated at a slight depth.

Open swales are developed about the heads of some of the intermittent-stream courses. These swales are somewhat shaded by the surrounding woods, and their damp soil bears

[5] *Pinus echinata* Miller and *Quercus marilandica* Muenchausen.

a good growth of grasses and sedges with frequent alder clumps. The permanent brooks, in many cases, arise from small but well developed swamps. Here the black soil is filled with organic débris and is covered or saturated with water for the major portion of the year. Black gum, red maple, alder, sweet gum, blue beech, and ash are present, the first three predominating. The shade is fairly dense and the floor bare except for occasional clumps of ferns and a few scattering grasses and flowering plants.

Small sphagnum-huckleberry bogs often form open areas within or alongside of the swamps. A typical merging of swamp and bog is situated within the village of Allardt but a few feet below the highest part of the divide. Here water stands from a few inches to a foot or more above the black muck soil, but is so filled with sphagnum clumps that only an occasional strip of open water is to be seen. Rising above the level of the sphagnum are clumps of southern huckleberry and a few scattering black gums and Jersey scrub pines, the latter mainly dying or dead. About the bases of all this taller vegetation the sphagnum rises in great rounded mounds that bear vigorous growths of cinnamon ferns, orchids,[6] and sedges. Arrowhead is abundant about the areas of open water and over the thinner parts of the sphagnum mats. Toward the margins of the bog the huckleberry clumps become more numerous and, with bamboo vine, red maple saplings, and alder, merge the bog with a gum swamp on one side and a stream-margin thicket on the other.

Natural marshes are rare; but the clearing of a number of the stream-margin thickets and swamps for pastures and hay-fields has resulted in a number of definitely marshy areas along the streams. Here, rank growths of sedges and native grasses are borne from numerous small hummocks, the areas between the hummocks varying from standing water to saturated muck.

Within half a mile, as one follows the stream courses away from the divide, the country becomes much more dissected.

[6] *Limodorum tuberosum* Linné.

The brooks begin to develop deep, steep-sided valleys with here and there vertical or overhanging cliffs of coarse sandstone. Their beds now run along horizontal rock strata, the frequent descents to lower levels marked by small falls and rapids. After cutting to a depth of between 100 and 200 feet, they reach a bedding of hard sandstone over shale that produces falls of nearly a hundred feet. Below the falls the valleys are deep gorges rimmed with vertical cliffs from whose bases steep talus slopes descend to flat, rocky stream beds that are overhung with dense rhododendron thickets.

Away from the divide the upland is reduced to the narrow sloping crests between the numerous, small, steep valleys. Such exposed crests are drier than the main part of the plateau and are thinly grown with black-jack oak and short-leaf pine. The higher valley slopes, especially those with a northern exposure, are much like the main plateau in soil and vegetation. On the lower valley slopes, the forests are of a much more mesophytic type: hemlock and beech come to replace the oaks and hickories; red bud, laurel, alternate-leafed dogwood, and sweet birch are common; and in the bottom of the ravines and gorges, rhododendron thickets are well developed. On the lower valley slopes the forest floor is deeply shaded; the soil is shallow with many outcrops and large rock fragments, but is rich in humus and is cool and moist. Wet, rotting wood, often covered with growths of fungus, is abundant.

The cliffs along the streams, and the bases of the high cliffs at the top of the talus slopes of the gorges are damp or wet and are splotched with mosses, liverworts, and walking-ferns; clumps of ferns and meadow-rue grow from the crevices and ledges. Along the foot of the cliffs are many long, low, shallow caverns, locally called "rock houses." Some of these are wet with seepage or are the sites of springs, others are fairly dry; but all form dimly lighted, cool recesses that are never exposed to strong light, summer heat, or drying winds.

Four miles west of Allardt the plateau ends abruptly in a series of connected coves that are really outlying arms of the

Highland Rim Section of the Interior Low Plateau Province.[7] The descent from the "Look Off," on the brink of the plateau, to the bottom of Buffalo Cove is about 600 feet. The first 75 or 100 of this is a sheer cliff of the sandstone rim rock that marks the boundary of the Cumberland Plateau in this region. From the foot of the cliff a steep talus slope (500 feet in a little over half a mile) leads down to the bottom of the cove. The slope is strewn with huge rock fragments and marked with frequent outcrops of limestone and shale. The out-cropping strata produce a somewhat terraced effect so that comparatively gentle slopes alternate with much steeper ones.

The rim of Buffalo Cove is but a short distance west of the divide between Big South Fork and the Obey River, and the streams flowing into the cove are small. The larger rills have cut shallow gorges into the face of the rim rock, through which they descend in alternate falls and short, level reaches; the smaller rills trickle over the face of the cliff to fall unbroken for fifty feet or more. Several of the rills, in their courses through the rim rock, and at its foot, are augmented by springs and diffuse seepage areas and tumble down the talus slopes as small brooks; many smaller rills are soon lost on the drier portion of the upper talus slopes.

Except for the entrance of the larger rills, the rim rock is almost everywhere vertical or overhanging. "Rock houses" are common and often their open sides are almost or quite hidden behind fallen masses of the rim rock. Considerable areas of the rim rock are wet with seepage and, where they have a northern exposure, or are otherwise shaded, bear a luxuriant growth of mosses and liverworts. At the foot of such damp cliffs is a zone of cool, moist, densely shaded woods. Here hemlock and rhododendron appear to be dominant, with moosewood, laurel, hard maple, blue beech, and sweet birch common. This zone is usually narrow, but in occasional sheltered spots extends down the slopes for several hundred feet.

[7] Fenneman, N. W. The Physiographic Provinces of the United States.

The larger portion of the talus slope is covered with an open oak-hickory-chestnut forest, but towards the bottom, and on the middle slopes that have a northern exposure, a more mesophytic forest is developed. Here beeches, sweet gums, tulip poplars, hard maples, and sycamores are common, and the shade is quite dense.

The small brooks descend the slopes through rough, shallow ravines and are often hidden by huge masses of fallen rock and crossed or deflected by fallen trees. Small falls and rapids are produced by the outcropping strata; springs and wet boggy banks are frequent. The plants of the cool, moist zone at the base of the rim rock follow the brooks down the slopes, and luxuriant growths of *Impatiens* and patches of wild ginger and meadow-rue are common.

The difference in elevation between the top of the plateau and the bottom of the coves, intensified, no doubt, by the sheltered position of the latter, makes a difference of from ten days to two weeks in the seasonal appearance of flowers and fruit and in the first appearance of the adults of several species of crane-flies.

Two types of habitat in which considerable work was done are not represented in the area about Allardt. One of these is the vicinity of Oneida, Scott County. Here the plateau has an elevation of 1450 feet at the headwaters of the small streams. The soil, derived from the Briceville Shales,[8] is a somewhat sandy, clay loam that bears more grass and a richer herbage than that about Allardt. Hard maples, beeches, tulip poplars, sweet gums, butter nut, and dogwood are among the common trees, while spring beauties, dog-tooth violets, Solomon's seal, and large trilliums *(T. erectum?)* were noted among the herbaceous plants. The small streams of the level upland have low mossy banks, but no stream-margin thickets were observed.

The other situation was the river margin, flood plain, and valley of Clear Fork, which forms the boundary between Fentress and Morgan counties. The station principally worked

[8] The Wartburg Folio.

was the vicinity of Peter's Ford, ten miles east of Allardt. Here the river flows through a narrow, U-shaped valley some 300 feet below the top of the plateau. The stream averages about 60 feet in width and is a succession of long, quiet, sandy-bottomed pools and short, stony riffles. The low banks are thickly grown with willows and other trees and bushes that overhang the water, and beyond these is a narrow but well developed flood-plain forest. Steep talus slopes rise from the flood plain to the foot of the valley rim rock, and these are quite like the upper talus slopes and rim rock of Buffalo Cove in physical features, plant associations, and crane-fly fauna.

A number of other situations: upland woods, ravines, river and creek flood plains and banks, small falls, wet cliffs, and marshes in various parts of the three counties were collected from, but they all resembled, rather closely, some of the situations described above.

Habitat Distribution of the Crane-Flies

One of the main objects of the field work was to ascertain the habitat distribution of the various species. When possible, field notes were taken on the habitat, behavior, and relative numbers and frequency of both adults and immatures. Supplementing this, and to obtain data on the numerous species for which detailed field notes were not obtained, intensive collecting was done at frequent intervals throughout the season in each type of habitat. One uniform situation was collected from at a time and each lot of specimens was given a catalogue number that referred to a description of the exact locality and its physical and vegetational characteristics. A list of all the species taken or observed and a notation as to their comparative abundance was usually included in the catalogue description, but no species was recorded as "observed" unless it had been previously *taken* in the same habitat and its identification was regarded as unmistakable. Some 153 lots of specimens were collected, comprising over 7000 individuals and 152 species.

This intensive collecting was almost entirely confined to

adults because of the impossibility of determining the immatures of many species without carefully rearing them. Unfortunately, although the adults of most crane-flies are definitely restricted by such physical factors as humidity and light, records based exclusively upon the occurrence of the adults give only a generalized picture of the habitat distribution of the species. The brief adult stage occurs at seasons when favorable conditions of humidity and temperature are frequently wide-spread; the adult's powers of locomotion are comparatively good; and when restricting factors are greatly reduced (as at night, or on damp cloudy days, or in an extensive habitat), it may range or be blown, some distance from the particular conditions necessary for immature existence.

When the adults are at all numerous the situation where they are taken must have included or been adjacent to the larval habitat, but in many cases, particularly in the Limoninae, conditions suitable for the immature stages are incidental to, or in the nature of a by-product of the general habitat in which the adult occurs, and not one of its invariable features. For example: among the crane-flies swept from the herbage of the stream-margin thickets, some of the species exist as larvae in the coarse damp sand; others in small pockets of saturated silt by the rill margin; another lives, attached to stones, beneath the flowing water; others in wet mosses and liverworts; others in drier mosses; some in water-logged, rotten wood; and still others in fungi or comparatively dry, rotten wood. For some of these species the actual habitat is the wet rotten wood, the fungi, or the flowing brook, and these may be provided by a variety of general habitats that differ markedly in topography and vegetational association from the stream-margin thickets. Conversely, certain of the stream-margin thickets had very little rotten wood,[9] and such species as *Atarba picticornis, Epiphragma fascipennis, E. solatrix,* and *Elephantomyia westwoodi* were rare or not taken at all,

[9] Some of the stream-margin thickets have probably been developed from swamps and wood bogs; others from the alder swales of the intermittent-streams.

though common in many of the stream-margin thickets of the region.

The classification of general habitats, that follows, is based upon field notes and upon a summary of all field catalogue descriptions. Under each general habitat are listed the species recorded from it. Those designated by an an asterisk (*) are to be referred primarily to this habitat or were very characteristic; those enclosed in parentheses [( )] are represented by only a few records and were either rare for the entire region, or else were accidental wanderers from some other general habitat.

I. Upland Habitats

1. *The Short-Leaf Pine and Black-Jack Oak Associations*

No species occurred typically in either of these associations, but a number of species were several times taken, during or after periods of wet weather: *(Nephrotoma virescens, Tipula manhatta, T. perlongipes, T. sackeniana, Brachypremna dispellans, Dicranomyia liberta, Rhipidia domestica).*

2. *The Oak-Hickory-Chestnut-Chinquapin Association*

(Ctenophora nubecula), (Nephrotoma eucera), N. ferruginea, Tipula flavoumbrosa, T. umbrosa, Brachypremna dispellans, Dicranoptycha megaphallus*, D. sobrina, D. winnemana, D. tigrina, Dicranomyia liberta, D. rara, Rhipidia domestica, Epiphragma solatrix, Atarba picticornis.*

3. *The More Mesophytic Upland Woods: Beech-Maple, and Oak-Hickory with a Mixture of Sweet Gum and Yellow Poplar*

Nephrotoma macrocera, N. virescens, Tipula submaculata, T. flavoumbrosa, (Liogma nodicornis), Dicranomyia rara*, Rhipidia domestica*, R. maculata, (R. shannoni), (Discobola argus), (Limonia immatura), (L. indigena), Epiphragma fascipennis*, E. solatrix, Limnophila adustoides, Atarba picticornis, Elephantomyia westwoodi, Gnophomyia luctuosa*, G. tristissima, Teucholabis complexa.*

4. *The Immediate Vicinity of Brooks through the Upland Woods*

These brooks ran through the more mesophytic woods, but in some cases the woods had been partially cleared.

Nephrotoma incurva, N. macrocera, (N. urocera), N. xanthostigma, Tipula bella*, (T. caloptera), (T. eluta), T. (hermannia), T. maculapleura*, Oropeza albipes, O. subalbipes, Dicranomyia diversa, D. gladiator, (D. globithorax), D. macateei*, Geranomyia canadensis, Pseudolimnophila contempta, P. toxoneura, Limnophila fuscovaria, L. adustoides, (L. subsimilis), Pilaria imbecilla, Eriocera cinerea, Gonomyia manca, G. subcinerea, G. sulphurella, Erioptera chrysocomoides, E. septemtrionis, E. caloptera, E. parva, E. armata*, E. graphica*, Molophilus auricomus, Helobia hybrida, Rhabdomastix flava, Cryptolabis paradoxa.*

5. *Stream-Margin Thickets*

(Nephrotoma tenuis), N. urocera, N. virescens*, (Tipula abdominalis), T. bella, T. tricolor, Oropeza albipes*, O. obscura, O. subalbipes, Brachypremna dispellans, Antocha* sp. near *saxicola, (Helius flavipes), Toxorhina muliebris, Dicranomyia diversa, D. liberta, D. rara, Geranomyia rostrata, Rhipidia domestica*, (Limonia fallax), L. triocellata, Tricyphona inconstans, Epiphragma solatrix*, E. fascipennis, Pseudolimnophila contempta, P. luteipennis, P. toxoneura, Limnophila macrocera*, L. fuscovaria*, L. adustoides, Pilaria quadrata, P. recondita*, P. tenuipes, Atarba picticornis*, Elephantomyia westwoodi, Eriocera aurata, Penthoptera albitarsis, Gonomyia manca, G. subcinerea, G. sulphurella*, Gnophomyia tristissima, Teucholabis complexa*, Erioptera chlorophylloides*, E. chrysocomoides*, E. septemtrionis, E. vespertina, E. caloptera, E. needhami, E. parva, Molophilus auricomus, M. floridensis, M. cumberlandensis, Helobia hybrida, Rhabdomastix flava.*

6. *Swamps*

Bittacomorpha clavipes, Nephrotoma virescens, Tipula perlongipes, Oropeza obscura, Rhipidia domestica, Tricyphona inconstans, Epiphragma solatrix, Pseudolimnophila contempta, Limnophila macrocera, L. adustoides, (L. consimilis), L. nigrogeniculata, Pilaria quadrata*, P. recondita*, P. tenuipes*, Atarba picticornis, Penthoptera albitarsis*, Teucholabis complexa, Erioptera chlorophylla, E. chlorophylloides, E. vespertina, E. caloptera*, Molophilus floridensis, M. forcipula, M. cumberlandensis.*

7. *Sphagnum-Huckleberry Bogs*

Bittacomorpha clavipes, Tipula perlongipes*, T. sackeniana, T. tricolor, Oropeza subalbipes, Brachypremna dispellans,*

Toxorhina muliebris, Dicranomyia diversa, (Pseudolimnophila australina), P. contempta, Limnophila macrocera, (L. laricicola), Pilaria recondita, P. tenuipes, Eriocera aurata, Penthoptera albitarsis, Erioptera chlorophylla*, E. vespertina.*

8. *Marshes and Open Marshy Stream Borders*

Bittacomorpha clavipes, Nephrotoma xanthostigma*, Tipula bella, T. manhatta*, T. perlongipes, T. sackeniana*, T. tricolor, Toxorhina muliebris*, Dicranomyia diversa, Geranomyia rostrata, Tricyphona inconstans, Pseudolimnophila contempta, P. luteipennis*, (Limnophila lutea), L. solstitialis, Pilaria tenuipes, Eriocera aurata*, Gonomyia manca, Erioptera chlorophylla, E. vespertina*, E. caloptera, E. parva, Molophilus cumberlandensis, M. forcipula.*

9. *Swales*

Nephrotoma urocera, N. xanthostigma, (Tipula hebes), T. manhatta*, Limnophila serotinella*, (Ulomorpha pilosella), Gonomyia manca, Erioptera parva, E. graphica, Molophilus floridensis.*

II. Ravine, Rim Rock, and Talus Slope Habitats

1. *Wet, Shaded Cliffs*

Nephrotoma virescens, Tipula apicalis, T. brevifurcata*, T. ignobilis*, T. oropezoides, Dolichopeza americana, Oropeza albipes, Elliptera illini*, Dicranomyia badia*, D. pubipennis*, D. pudicoides*, D. simulans*, D. stulta*, Geranomyia diversa*, G. rostrata, (Dicranota notabilis), Eriocera aurata, Penthoptera albitarsis.*

2. *The Hemlock-Rhododendron-Maple-Blue Beech Association, at the Foot of the Rim Rock*

Nephrotoma incurva, (Tipula annulicornis), T. cayuga, Dicranomyia diversa, D. pubipennis, D. rara, (Rhipidia fidelis), R. maculata, Discobola argus*, (Limonia fallax), (L. tristigma), Adelphomyia pleuralis*, Tricyphona inconstans, Rhaphidolabis forceps, (Ula elegans), Epiphragma fascipennis, Pseudolimnophila toxoneura, Limnophila fuscovaria, L. areolata*, Ulamorpha pilosella*, Atarba picticornis, Elephantomyia westwoodi, Erioptera needhami, Ormosia adirondacensis, Molophilus auricomus, M. cramptoni, M. cumberlandensis.*

3. *Shaded Cliffs and Rock Masses, Characterized by Growths of Lichens and Thin Mosses*

Although damp and cool these formed quite a different situ-

ation from the wet cliffs, which were characterized by seepage and trickling water.

Longurio testaceus, Tipula algonquin, T. hermannia*, T. oropezoides, Dolichopeza americana*, Oropeza albipes, O. sayi, Dicranomyia morioides.*

4. *Talus Slope Brooks and Rills*

Longurio testaceus, Nephrotoma virescens, Tipula apicalis, T. ignobilis, Oropeza sayi, O. subalbipes, Brachypremna dispellans, Elliptera tenessa, Dicranomyia badia, D. diversa, D. liberta, D. morioides*, D. pubipennis*, D. stulta*, Adelphomyia pleuralis*, Tricyphona inconstans, Rhaphidolabis forceps*, (Pseudolimnophila australina), P. contempta, P. luteipennis, P. toxoneura*, Limnophila consimilis, L. solstitialis*, (L. niveitarsis), Ulamorpha pilosella*, Pilaria recondita, P. tenuipes, Atarba picticornis, Eriocera brachycera, Penthoptera albitarsis, Gonomyia manca, (G. florens), Teucholabis complexa, Lipsothrix sylvia*, Erioptera septemtrionis, E. caloptera, E. needhami, E. parva, Molophilus auricomus, M. cramptoni, M. cumberlandensis, Dasymolophilus niphadias*.*

5. *The Open, Oak-Hickory Woods of the Drier Talus Slopes*

Nephrotoma ferruginea, Tipula umbrosa, Dicranoptycha sobrina, D. tigrina, D. winnemana*, (Dicranomyia liberta), (Epiphragma solatrix).*

6. *The Mesophytic Woods of the Lower Talus Slopes and the Cove Bottoms*

Nephrotoma eucera, N. macrocera, N. tenuis, N. virescens, Tipula flavoumbrosa, (T. fuliginosa), T. mallochi*, (T. mingwe), T. submaculata*, (T. translucida), Limonia indigena*, L. triocellata, (Ula elegans), Epiphragma fascipennis*, E. solatrix, Atarba picticornis, Gnophomyia luctuosa, Teucholabis complexa.*

III. Larger Stream Habitats

The talus slopes, talus slope brooks, and rim rock cliffs of the valleys of the larger streams are practically the same as those of the coves and large ravines, and their fauna is included under II, above.

1. *River and Creek Flood Plains*

Nephrotoma calinota, N. macrocera*, N. tenuis*, N. virescens*, (Tipula mingwe), T. submaculata, (T. trivittata), Dicranoptycha sobrina, Dicranomyia diversa, D. gladiator*,*

(D. globithorax), Epiphragma fascipennis, (Pilaria quadrata), Atarba picticornis, Elephantomyia westwoodi, Gonomyia manca, G. subcinerea, Teucholabis complexa, Erioptera vespertina, E. caloptera, E. needhami, E. parva, Molophilus forcipula.

2. *River Banks*

(Nephrotoma polymera), (Oropeza subalbipes), Antocha sp., near *saxicola*, Dicranomyia liberta, Eriocera fuliginosa*, E. fultonensis*, Gonomyia cognatella, G. sulphurella, Erioptera septemtrionis, E. armata, Molophilus auricomus, Cryptolabis paradoxa*.*

3. *Dianthera-Grown Gravel Banks and Riffles*

(Tipula caloptera), T. concava, Dicranomyia diversa, (Geranomyia distincta), Gonomyia sulphurella.*

Annotated List of the Species[10]

Bittacomorpha clavipes (Fabricius)

Fentress County—June 26 to August 12.

Common in the marshy areas, sphagnum-huckleberry bogs, swamps, and the more swampy of the stream-margin thickets. Larvae and pupae were taken in large numbers from the shallow pools between the grass hummocks of the marshes.

Ctenophora nubecula Osten Sacken

Fentress County—June 14.

A single female was taken at dusk, hovering along a fallen oak that lay in a partial clearing of the oak-hickory woods. The wood was still sound, although the bark was beginning to come away from the trunk. Apparently the fly was interrupted while oviposting, for her egg complement was about half used.

Longurio testaceus Loew

Fentress County—June 21 to July 20.

Scarce. All records are from the vicinity of a shaded rill

[10] The taxonomic arrangement followed is that suggested by Alexander, C. P., 1927. The Interpretation of the Radial Field of the Wing in the Nematocerous Diptera, with special reference to the Tipulidae. Pro. Linn. Soc. New South Wales, iii, pt. 2: 41-72, 92 figs.

of the upper talus slope of Buffalo Cove. A male was taken as he hung from the under side of a projecting ledge of the rim rock; all six feet held to the ceiling-like support while the body and wings hung limply. The position was much like that assumed by a damsel fly when hanging from a similar support. An ovipositing female was taken from the sandy, grass-and-sedge-grown margin of a small spring rill at the foot of the rim rock, on July 20. Several positive sight identifications were made for both males and females that were resting high on the vertical faces of huge, moss-grown rock masses. When flushed they flew still higher up the rocks or among the leaves of the taller trees.

Nephrotoma calinota (Dietz)[11]

Morgan County—June 12.

Numerous on the above date, in the partially cleared flood plain forest of Clear Fork. That night a number of females came to a lighted sheet on the talus slope, overlooking the flood plain. A week later not a single specimen could be found in this same location.

Nephrotoma eucera (Loew)

Fentress County—June 11.

Scarce. From the mesophytic woods of the upland, and from the lower talus slopes of a cove. One male was also taken at a lighted sheet.

Nephrotoma ferruginea (Fabricius)

Fentress County—August 23; Cumberland County (T. H. Hubbell)—July 6 and 15.

[11] I cannot separate these specimens from topotypes of *N. calinota*, in the Univ. of Mich. collection, one of which bears Dr. Dietz's MS. label, "*calinota*." However, in the same paper in which *calinota* was described, Revision of the N. A. Species of the Tipulid Genus *Pachyrhina*. Trans. Amer. Ent. Soc., 1918, Dr. Dietz describes a closely allied species, *N. montana*, from Black Mountain, North Carolina, much closer to the Cumberland Plateau than the type locality of *N. calinota*, the Upper Peninsula of Michigan.

From the oak-hickory woods of the upland and the open talus slopes. These records probably represent adults of the second generation for the year.

Nephrotoma incurva (Loew)

Fentress County—June 11 to August 13.

Not common. All were taken from the vicinity of wooded brooks, both of the upland and of the upper talus slopes.

Nephrotoma macrocera (Say)

Fentress County—June 6 to 26 and August 20; Scott County—May 28 to 30 and August 18.

Common about upland wooded streams, in the mesophytic woods of both the upland and lower talus slopes, and in wooded or partially cleared river flood plains. The collection dates suggest that there are probably two generations per year in this region.

Nephrotoma polymera (Loew)

Fentress County—June 19.

A single female was swept from the thick shrubbery overhanging the banks of Clear Fork.

Nephrotoma tenuis (Loew)

Fentress County—June 12 to July 5.

Not common. Most of the records are from the flood plain forest of Clear Fork, but it was also taken from the mesophytic woods of the lower talus slopes of Buffalo Cove and from a stream-margin thicket of the upland.

Nephrotoma urocera (Dietz)

Fentress County—July 5 to August 12.

Numerous in the more open portions of the stream-margin thickets. Also taken in considerable numbers from the open swales.

Nephrotoma virescens (Loew)

Fentress County—June 10 to September 3; Morgan County —June 19; Cumberland County (T. H. Hubbell)—July 7.

Abundant in most wet or damp situations of both upland, talus slopes, and river flood plains. More characteristic of shaded situations but also occurred about some of the open brooks. At night this species ranged widely and was frequently taken then, while sweeping the shrubbery of the upland pine-oak and oak-hickory woods. Pairs in copulation were found at night on leaves of tall shrubbery and undergrowth. Both sexes came freely to light.

Nephrotoma xanthostigma (Loew)

Fentress County—June 6 to September 3; Scott County—May 29.

Numerous in grassy swales of the upland, in the open marshes, and about the partially cleared banks of upland brooks.

Tipula abdominalis Say

Fentress County—June 7.

Two females from a stream-margin thicket of the upland.

Tipula annulicornis Say

Fentress County—July 12.

Two males from a clump of ferns at the base of a wet, shaded cliff. Since no females were taken this species might conceivably be *T. synchroa* Alexander, which cannot be separated from *T. annulicornis* by the male sex. However, *T. annulicornis* seems regional with records from Southern Indiana and Maryland, while *T. synchroa* is, at present, known only from Alachua County, Florida.

Tipula algonquin Alexander

Fentress County—June 24 to August 11; Scott County—July 24.

Numerous in dark, cool crevices about shaded cliffs, in crannies among tumbled piles of fallen rim rock, and in the darkest of the drier "rock houses." In all cases the rock is slightly damp and grown with thin coats of tightly clinging mosses.

Tipula apicalis Alexander

Fentress County—June 11; Morgan County—June 12 and 19.

From the deeply shaded, rocky talus slope brooks of Buffalo Cove and from the wet "rock houses" of the valley of Clear Fork.

Tipula bella Loew

Fentress County—June 26 to August 30; Scott County—August 18.

Not common. From the upland marshes, stream-margin thickets and brooks, and from *Dianthera*-grown riffles of New River.

Tipula bicornis Forbes

Fentress County—date unknown.

A single male was taken from a spider web in a barn on the upland. Probably the adults are on the wing in May.

Tipula brevifurcata Alexander

Fentress County—June 9, 10, and 28; Scott County (type locality)—May 30.

Rare. All were taken from about wet, mossy cliffs or from the vicinity of small waterfalls through the rim rock. One partially eaten adult was found still partially enclosed in the pupa skin, which projected from the wet mosses and algae at the brink of a small, shaded falls. A careful search revealed perhaps half a dozen other empty pupa skins in the same sort of situation.

Tipula caloptera Loew

Fentress County—June 14; Scott County—August 18.

A female from the course of a small, wooded, upland brook, and a teneral male from a clump of *Dianthera* growing in the margin of New River.

Tipula cayuga Alexander

Fentress County—June 21 to 25.

Several specimens from the cool, hemlock-rhododendron woods at the foot of the rim rock of Buffalo Cove.

Tipula concava Alexander

Scott County—August 18.

Numerous among the *Dianthera* patches of the riffles and gravel bars of New River. This appears to be the typical and almost exclusive habitat of this species. In southern Indiana (type locality) and in southern Michigan the adults were swept from patches of *Dianthera* and the larvae and pupae obtained from the coarse sand about the roots of these plants, at the water's margin.

Tipula eluta Loew

Scott County—May 30.

A single male taken from the margin of a brook through the upland, beech-maple woods.

Tipula flavoumbrosa Alexander

Fentress County—June 14 to 26; Scott County—May 29.

Numerous in several well-wooded areas, both of the upland and the lower talus slopes. These specimens show considerable variation in the shape of the eighth sternite of the male hypopygium but are, I believe, clearly referable to *T. flavoumbrosa.*

Tipula fuliginosa Say

Fentress County—June 13.

One female from the mesophytic woods of the bottom of Buffalo Cove.

Tipula hebes Loew

Fentress County—September 3.

A few specimens from a grassy, upland swale. This species probably becomes more common in middle and late September.

Tipula hermannia Alexander

Fentress County—June 8 to September 3; Morgan County —June 12.

Abundant about well shaded cliffs and mossy rock masses of the upper talus slopes. Nearly every situation of this sort was inhabited. *Tipula hermannia* was taken in all situations

from which *T. algonquin* was obtained but was much more widespread than the latter species and less restricted to dense shade.

Tipula ignobilis Loew

Fentress County—June 19 to July 9; Morgan County—June 12 to 19.

Numerous about the wet, shaded rim rock cliffs and the rocky brooks of the upper talus slopes.

Tipula maculapleura Alexander

Fentress County (type locality)—June 14 to 18; Morgan County—June 19.

Taken from the herbage or shrubbery of four different and widely separated upland brooks and from a rill of the lower talus slopes of the valley of Clear Fork.

Tipula mallochi Alexander

Fentress County—June 11 to 28.

Numerous on the wooded lower slopes of Buffalo Cove. Usually from the more luxuriant woods that border the lower brooks.

Tipula manhatta Alexander

Fentress County—August 10 to September 3.

Adults of this species began to emerge in great numbers from the grassy swales, sedge marshes, and wet hay-fields of the upland, in middle August. Females came freely to a light that was half a mile or more from the nearest known habitat.

Tipula mingwe Alexander

Fentress County—June 24 and July 11.

Rare. Records are for the mesophytic woods of a cove bottom and the flood plain forest of Clear Fork.

Tipula oropezoides Johnson

Fentress County—June 10; Morgan County—June 12.

All records are for the vicinity of wet, shaded cliffs. On

June 12 several specimens were found hanging from the dripping, mossy roofs of some deeply shaded "rock houses."

Tipula perlongipes Johnson

Fentress County—June 6 to July 15.

Numerous in the swamps, sphagnum-huckleberry bogs, and marshes of the upland.

Tipula sackeniana Alexander

Fentress County—June 30 to August 12.

Abundant in the grass and sedge marshes, the wet hayfields, and the sphagnum-huckleberry bogs of the upland. Restricted to rather open situations and did not occur in the swamps or well shaded stream-margin thickets.

Tipula submaculata Loew

Fentress County—July 2 and 20; Scott County—May 29.

From typical mesophytic woods. The Fentress County specimens are from a flood plain forest and the lower slopes of Buffalo Cove; the Scott County specimens from a beech-maple-yellow poplar woods.

Tipula translucida Doane

Fentress County—June 13.

A single male swept from the mature mesophytic woods of the bottom of Buffalo Cove.

Tipula tricolor Fabricius

Fentress County—June 25 to August 13.

Common in the upland marshes, the sphagnum-huckleberry bogs, and the stream-margin thickets. Frequently came to light.

Tipula trivittata Say

Fentress County—June 12.

A male and female from the wooded flood plain of Clear Fork.

Tipula umbrosa Loew

Fentress County—June 7 to 12.

Fairly numerous in the better developed oak-hickory woods of the upland and the talus slopes. Both sexes came to light.

Dolichopeza americana Needham

Fentress County—June 8 to July 14; Scott County—May 30 and July 24.

Common in damp, deeply shaded situations. A characteristic inhabitants of the "rock houses" and the crevices of the tumbled rock masses that lie on the shaded talus slopes. Pairs in copulation were often taken, the female hanging from the roof of the cavity by her prothoracic legs or, sometimes, by the prothoracic and *one* mesothoracic leg. The male hangs head downward, supported solely by the clasp of his genitalia, his legs sprawled out like the radii of a circle.

Oropeza albipes Johnson

Fentress County—June 6 to August 16; Morgan County—June 12 to August 5; Scott County—May 28 to July 24.

Abundant. Appeared equally characteristic of wet "rock houses," of the shaded base of dripping cliffs, of upland stream-margin thickets, and of the mossy banks of shaded brooks. Apparently the habitat distribution is governed largely by the occurrence of mats of wet mosses, the habitat of the immature stages, and the presence of deep shade and high humidity for the adults.

Oropeza obscura Johnson[12]

Fentress County—May 31 to September 3; Morgan County—June 12 to August 5; Scott County—May 28 to 30 and August 18.

[12] Among the large series (about 100) taken of *O. obscura* are a number of specimens that now have the appearance of *O. obscura polita*, with the dorsum of the thorax highly polished. In these specimens, however, the polished appearance is due to post-mortem changes, associated with slow and imperfect drying.

Abundant. From the shaded, rocky, upper talus slope brooks, "rock houses," beneath overhanging banks of the upland brooks, and from large hollows in standing trees. Rare in the stream-margin thickets. The larvae occur in rather dry mosses on rocks, or earthen stream banks, or logs and exposed tree roots. The adults appear to be more restricted by light and less restricted by humidity than those of *O. albipes.*

Oropeza sayi Johnson

Fentress County—August 13.

Rare. Taken from the course of a shaded, rocky, talus slope brook in Buffalo Cove.

Oropeza subalbipes Johnson

Fentress County—June 6 to August 12; Morgan County—June 12; Scott County—May 29 and 30.

Common. More confined to the upland than *O. albipes.* Taken from the stream-margin thickets, sphagnum-huckleberry bogs, and from the banks of both cleared and wooded brooks. A few records are from the talus slope brooks and from the river bank of Clear Fork, but it was not collected from the "rock houses" or the base of the wet rim rock. The larvae have been taken from mats of liverworts and mosses on sodden logs and wet earth banks.

Brachypremna dispellans (Walker)

Fentress County—June 24 to July 9; Cumberland County (T. H. Hubbell)—July 9.

Scarce. A score of specimens were taken singly from a variety of moist shaded situations, and from brush piles and logs in the drier woods. The most common habitat was the stream-margin thickets.

Liogma nodicornis Osten Sacken

Scott County—May 29.

A single male, taken from the herbage of the mesophytic upland woods.

Antocha n. sp. (near *opalizans* O. S.)[13]

Fentress County—June 6 to July 22; Morgan County—June 19.

Numerous about a number of the small upland rills and brooks and *abundant* about the banks and riffles of Clear Fork.

On the night of June 10, between 8:30 and 10:30, this species was observed ovipositing, in great numbers. The eggs were laid just beneath the water line in the thin layer of algae and silt that coated the rocks projecting from the riffles. The stream was rather low at this time and the tops of the rocks were several inches above the water, which had a depth of from 12 to 18 inches. As many as a dozen females were ovipositing at one time about the edges of a rock whose emerged surface was no larger than a dinner plate. Although this species often came to light, the ovipositing females apparently paid no attention to the rather strong beam of my acetylene "Jack-light." An ovipositing fly would usually stand just above the water line and face the top of the rock, so that the top of her abdomen reached to the water. Her ovipositor was probed about in the algal scum, just beneath the water line, until a suitable spot was found; the ovipositor was then thrust deeper into the scum and bended to a sharp angle to the rest of the abdomen. The depositing of the egg (or eggs?) took from 5 to 7 seconds and then the ovipositor was withdrawn. Another spot was then sought and the performance repeated, often without the fly moving her feet. After this had been repeated five or six times the fly usually walked to the top of the rock and remained quiet for several minutes, then walked to a dfferent place at the water's edge, or flew to a nearby rock and repeated the whole process. It was estimated that well over 500 females were ovipositing at one time at this one riffle, and the numbers were equally great at the two other riffles that were visited that night.

No pairs were observed in copulation at night, but several

[13] These were submitted to Dr. Alexander, for his opinion, and were pronounced an undescribed species, but pending a revision of *Antocha*, for which material is now being accumulated, are left undescribed.

pairs were taken in mid-afternoon from the shrubbery overhanging the river's edge.

Antocha sp. *incertis*

Cumberland County (T. H. Hubbell)—July 12.

These were all females and cannot be determined without the males, although they are evidently different from the Fentress and Morgan county species. Species were submitted to Dr. Alexander, who does not believe them to belong to any described species.

Elliptera illini Alexander

Fentress County—June 10 to 21; Morgan County—June 12; Scott County—May 28.

Locally abundant about very wet, shaded cliffs and the margins of small waterfalls. The dripping rock always bore a thin growth of algae and tightly adhering mosses and was covered with a scant, brown, diatomaceous sludge; but in no case did the vegetation and sludge form more than a thin, uneven coat that left part of the wet rock exposed. Such situations were frequent along the rim rock of the coves and the larger stream valleys.

Teneral and emerging adults were noted on May 28, and on June 10 and 13. Matured pupae project their heads and thoracic region above the silt and algal strands shortly before emergence. Emergence is rapid; the legs and abdomen are withdrawn with but little effort, and the pale, soft adult rests for some minutes on the projecting pupa skin, and then flies to some projecting tuft of algae or the leaf of a nearby shrub before the teneral condition has disappeared.

In spite of the abundance of adults, the immature stages and the empty pupa skins are hard to find. Both the larvae and the pupae live within delicate, indefinite tubes that are concealed beneath the strands of algae or moss and the adhering silt. The tubes that could be traced always led to some tiny crevice or silt-filled pit in the rock, or beneath some denser tuft of algal strands. The few larvae and pupae that

were obtained were in these protected situations, and it seems probable that most feeding and activity takes place at night.

Several pairs of adults were observed in copulation on June 10 and 13. Several males could usually be found hovering up and down, along the wetter portion of the cliff. When one came in contact with a female, she took wing and the two went through a scrambling flight along the face of the cliff where they soon alighted. The male now stood over the female who was imprisoned by his legs and body. The male then curved his abdomen below the female's and bended up his forceps to seize the third or fourth abdominal somite of the female from beneath. After a few moments' rest another fluttering struggle took place, during which the male slipped his forceps down along the female's abdomen, without relinquishing their hold, until the tips of his dististyles reached the base of the tergal valves of her ovipositor. The base of the forceps was now pulled around the tip of the sternal valves, and by flexing the dististyles the sternal valves of the ovipositor were pulled into the genital chamber of the male. Once this was accomplished the flies rested quietly in copulation from 10 to 30 minutes. During this time they may be approached and picked up with the forceps.

Oviposition was observed on a number of occasions. The female flies along the face of the wet, algae-grown cliff, or may alight and walk about the surface until she comes to a suitable spot. The eggs are laid beneath algal strands or in tiny sludge-filled crevices of the rock. The actual work of depositing the eggs is slight but is preceded by considerable probing about with the ovipositor which seems to slide about on the surface of the rock, first in one direction and then in another until it comes into contact with a tightly adhering strand of algae or moss, or slips into one of the tiny crevices. In contrast with the ease with which a pair in copulation may be approached, the ovipositing females were wary and took flight at the slightest movement of a nearby object.

Small, dark, cursorial spiders were numerous on the wet cliffs where *E. illini* occurred and were now and then seen feed-

ing on one of these flies. Both teneral and fully matured individuals were captured. Many small salamanders were active about the lower cliffs at night and probably fed to a considerable extent upon both immatures and adults, since *E. illini* formed the principal population of the cliffs where the salamanders were taken.

Elliptera tennessa Alexander

Fentress County (type locality)—June 15 and 25.

Apparently rare, as careful collecting could discover but ten specimens. All were taken from the overhanging vegetation of a deep, rocky stream-bed at the bottom of Buffalo Cove.

Dicranoptycha megaphallus Alexander

Fentress County (type locality)—June 10 and 23.

A male was taken at light on the upland, and a pair in copulation was swept from the shrubbery of an upland oak-hickory woods.

This species has since been taken in numbers from a similar situation in northwest Florida, and the immature stages have been obtained from the moderately dry soil of an oak-hickory woods.

Dicranoptycha sobrina Osten Sacken

Fentress County—June 14 to August 8; Morgan County—June 12 and 19; Scott County—May 29.

Numerous in the open woods of the dried talus slopes and from a partially cleared portion of the flood plain of Clear Fork. Less numerous in the oak-hickory woods of the upland.

Dicranoptycha tigrina Alexander

Cumberland County (T. H. Hubbell)—July 14.

Apparently common on the slopes of Grassy Cove, on this date.

Dicranoptycha winnemana Alexander

Fentress County—June 11 to August 7.

The most characteristic crane-fly of the open oak-hickory

woods of the talus slopes, where it was abundant in the latter part of June and throughout July. The August records are from somewhat more moist woods of the upland.

Helius flavipes (Macquart)

Fentress County—June 6 and August 9.

Rare. All records are from the upland; either the specimens came from a partially cleared stream-margin thicket, or came to light.

Toxorhina muliebris Osten Sacken

Fentress County—June 25 to July 22.

Often numerous in the sphagnum-huckleberry bogs, the more open stream-margin thickets, and in marshes that were somewhat overgrown with low bushes and alder clumps. A few specimens were taken above a small sphagnum clump at the bottom of a small ravine.

Dicranomyia badia (Walker)

Fentress County—June 6 to 28 and August 8 to 12; Morgan County—June 19; Scott County—May 29.

Numerous in the few, isolated spots where it was taken: damp, well shaded situations, either at the base of the rim rock or about the upper talus slope brooks. On August 8 adults were found emerging from the slightly drier edges of the wet algal and moss mats in which *Geranomyia diversa* occurred. Pupae and a few larvae were found in these drier edges of the algal mats and a number of empty pupae skins projected as far as the base of their wing pads. Several shriveled pupae were seen, covered with the fruiting stalks of an entomophagus fungus.

It seems probable that there are two generations per year: the June records from the earlier generation, the August from the later. During July, the habitats from which June and August specimens were taken were repeatedly and carefully collected from, without a single record.

Dicranomyia diversa Osten Sacken

Fentress County—June 7 to August 9; Morgan County—August 5; Scott County—May 28 and August 15.

Though not common in any one habitat, this species occurred in nearly all situations except the dry woods of the upland and of the middle talus slopes. This widespread occurrence is no doubt due to the high frequency of the larval habitat: small, moist tufts or skins of mosses of various species. Both sexes came freely to light.

Dicranomyia gladiator Osten Sacken

Fentress County—July 24; Scott County—May 28 and August 15.

All records are for damp, grassy situations: a clearing in low upland woods, and the open flood plain of White Oak Creek.

Dicranomyia globithorax Osten Sacken

Fentress County—July 2 and 12.

Two specimens: one from beside a shaded talus slope rill, the other from the bank of a small, wooded brook on the upland. The immature stages occur in fungus growths of rotting hardwood logs.

Dicranomyia liberta Osten Sacken

Fentress County—June 28 to July 22: Cumberland County (T. H. Hubbell)—July 7.

The adults of this species are among the most widely ranging of our local Limoniinae. Occasional specimens were taken from nearly all the habitats of the region except the cool, moist base of the rim rock. The characteristic habitat appeared to be the oak-hickory woods and the drier, outer edges of the stream-margin thickets.

Dicranomyia macateei Alexander

Fentress County—July 15; Scott County—August 15.

From the immediate vicinity of small brooks through the

upland woods. The immature stages occur in the fungi *(Poria)* of very damp or wet decaying logs. Nearly all the logs or stumps inhabited by this species have been found close beside shaded brooks or seepage areas.

Dicranomyia morioides Osten Sacken

Fentress County—June 11 to 28.

Numerous about mossy rocks of the shaded, lower stream courses of Buffalo Cove. The immature stages live in and beneath the thin, tightly-clinging coat of mosses that partially cover the large boulders beside the stream beds.

Dicranomyia pubipennis Osten Sacken

Fentress County—June 12 to August 16; Morgan County—June 12; Scott County—May 30 and July 24.

Abundant about the upper talus slope brooks, about seepage areas at the base of the rim rock, and in the hemlock-rhododendron woods at the top of the talus slopes. Rare about the upland stream courses.

Dicranomyia pudicoides Alexander

Fentress County (type locality)—June 9 to August 30; Morgan County—June 19; Scott County—May 30 and July 24.

Abundant within its very restricted habitat. All specimens were collected or seen in the immediate vicinity of dripping cliffs that bore thick mats of algae and mosses. Here the adults rest on the wet, rope-like strands of algae, on the wet rocks, and behind the thin sheets of falling water. A few were noted on the underside of leaves of the shrubbery that grew against the wet cliffs.

The larvae live in thick, irregular, gelatinous tubes among or beneath the saturated algae and mosses. Before pupation the tube is extended to the surface of the algal mat and the pupa stage is spent in the mouth of the tube, just below the surface of the algae. The tubes are semi-transparent with a distinct greenish tinge, and the larvae and pupae are of the light green color of new algal strands. Late in pupal life

the eyes and breathing horns become dark brown. The color of the tubes and the immature stages make their detection difficult, but once discovered they were found to be present in large numbers, scores of larvae and pupae in a square foot of algae.

On July 11 a female was noted emerging. The pupa was projecting, as far as the wing pads, from a long, dripping "rope" of algae that hung from a projecting ledge. The head and antennae were almost instantaneously freed by the splitting of the pupa skin, and, after a very brief pause, the legs were smoothly withdrawn from their sheaths. A few rhythmic pulsations of the greatly swollen abdomen freed all but the tip of the body, and the fly bent over, placed its feet on the distal end of the pupa skin, and withdrew the tip of the abdomen from the skin. The whole emergence took less than 30 seconds. The fly remained standing on the empty pupa skin: its abdomen was greatly dilated and elongated and its wings moist and soft. The whole body had a light, pea green color. Placed in a dry shell vial of 25 ml. capacity, the fly assumed normal size in about 45 minutes, the walls of the shell vial becoming beaded with moisture.

Numerous observations show that the flies become active and appear fully hardened in from 40 to 60 minutes after emerging, but the green coloration persists much longer, and even after 24 or 36 hours traces of green can be noted at the base of the abdomen and at the joints of the legs.

Dicranomyia rara Osten Sacken

Fentress County—June 6 to August 9; Scott County—May 30.

Taken in small numbers from the stream-margin thickets and from all but the driest of the upland and talus slope woods. The immature stages were frequently found in fungus growths within wet, rotting logs, usually between the bark and the rotting sap wood. In the drier woods the larvae were usually confined to the moist area beneath the log, the portion not in contact with soil too dry to be inhabited. Both the

larvae and pupae of this species can stand rather long periods of desiccation, retreating to the most moist portion of the fungus growth and there drying slowly, they may be revived by wetting after they have become markedly shriveled.

Dicranomyia simulans (Walker)

Fentress County—July 9 to 20; Morgan County—August 5; Scott County—July 24.

Scarce except for the brinks of a few waterfalls in the Brushy Mountains of Morgan County. All specimens were taken from about small waterfalls and dripping cliffs. The adults rest on the wet rocks behind the falling water or cling to the wettest parts of the cliffs. Larvae and pupae were found among the moss strands through which the water seeped or ran in tiny trickles.

Dicranomyia stulta Osten Sacken[14]

Fentress County—June 10 to July 19; Morgan County—June 12 and 19; Scott County—July 24.

Abundant about wet shaded cliffs, the vicinity of waterfalls, and the rocky brooks of the upper talus slopes. The larval habitat is precisely that of *Dicranomyia pudicoides* and the larvae and pupae of the present species were abundant in the same mats of wet algae. The adult habitat is also the same as that of *D. pudicoides*, save that the adults of *D. stulta* are much less restricted to the immediate vicinity of the

[14] Over 200 specimens of this variable species were taken. Wide extremes were found in coloration, venation, and the pubescence of the antennal joints, each feature varying independently of the others. I believe it very probable that not only *D. monticola* Alexander but also *D. moniliformis* Doane are synonyms of *D. stulta*. Alexander has already, in several papers, called attention to the possible synonomy of *D. monticola* with *D. stulta* and the present series, all taken from one locality and the same habitat, seems to establish the synonymy. I have not seen the types of *D. moniliformis*, but in the present series have many individuals that answer perfectly Doane's description and intermediates between these and what are regarded as typical specimens of *D. stulta*.

wet, shaded cliffs, and may be swept in numbers from the herbage and shrubbery about the foot of the cliffs.

Geranomyia canadensis (Westwood)

Fentress County—August 11 and 12; Scott County—May 30.

Scarce. The Fentress County records are for individuals that came to light on the upland. The Scott County specimens were swept from the banks of a small rill in the mesophytic upland woods.

Geranomyia distincta Doane

Scott County—August 19.

A male and a teneral female, swept from a growth of *Dianthera,* along the margins of New River.

Geranomyia diversa Osten Sacken

Fentress County—June 11 to August 30; Morgan County—August 5; Scott County—May 30 and July 24.

Abundant about shaded, wet cliffs and waterfalls, and restricted to the vicinity of such situations. The adults rest in large numbers on the wet rock faces, often behind thin sheets of falling water, or on the ferns and meadow rue that grow from the brinks and crevices of the wet cliffs.

Larvae and pupae were abundant in and beneath thick mats of dripping algae that grew on the wettest part of the shaded cliffs. The larvae inhabit rather thick, slimy, gelatinous tubes that are buried in the algae and sludge. The larvae are active and protrude the anterior ends of their bodies from the tubes to feed on the surface of the algal mats, but quickly withdraw if closely approached or if the mats are touched.

The algal mats inhabited by the larvae of *G. diversa* are much wetter than the larval habitat of *Dicranomyia badia* and much thicker and more matted than the thin, scant growths of algae and moss inhabited by *Elliptera illini. Diacranomyia pudicoides* and *D. stulta* occasionally occurred in the same

larval habitat but were more numerous in situations where *G. diversa* was scarce or absent. The algal mats typically inhabited by *G. diversa* had a darker, more bluish coloration than those where *D. pudicoides* and *D. stulta* were abundant, and adhered to the rock wall in a more dense, felt-like coat.

Geranomyia rostrata (Say)

Fentress County—June 7, 20, and 30; Morgan County—August 5; Scott County—May 29.

Rather scarce. All records are for upland brooks and stream-margin thickets or from the vicinity of small waterfalls. The larvae and pupae occur in wet mosses and liverworts that grow on wet rocks or on the wet earth of stream banks.

Rhipidia domestica Osten Sacken

Fentress County—June 13 to August 20; Morgan County—August 5; Scott County—May 29.

Abundant in the wooded uplands, both from the oak-hickory and beech-maple woods as well as from the stream-margin thickets. It was also taken from the wooded flood plains. Both sexes came to light in numbers.

Rhipidia fidelis Osten Sacken

Fentress County—June 7, 12, and 21.

Only three specimens were taken: one came to light, on the upland, the other two were swept from the herbage of the talus slope brooks.

Rhipidia maculata Meigen

Fentress County—June 11 to July 24; Scott County—May 29.

Scarce. From the banks of an upland brook through mesophytic woods, from the hemlock-rhododendron association of Buffalo Cove and Clear Fork, and from the banks of brooks on the upper talus slopes.

Rhipidia shannoni Alexander

Scott County—May 29.

A single male swept from the undergrowth of a partial clearing in the beech-maple woods of the upland.

Discobola argus (Say)

Fentress County—June 28, August 10, 11, and 22; Scott County—May 28.

Rare. The Fentress County records are from the hemlock-rhododendron woods of Buffalo Cove and from the gorge below Northrup Falls. The Scott County record is for a female taken from the trunk of a yellow poplar in a low moist woods.

Limonia fallax Johnson

Fentress County—June 18 and 20.

Two males: one from an upland swamp, the other from a deeply shaded, talus slope brook.

Limonia immatura Osten Sacken

Fentress County—June 10 and July 3.

Two females: one from a stream-margin thicket, the other from one of the more mesophytic of the upland, oak-hickory woods.

Limonia indigena Osten Sacken

Fentress County—June 11 to July 24; Scott County—May 29.

Not common, but taken in small numbers from a variety of mesophytic woods: in the cove bottom, from the flood plains, and from the beech-maple woods of the upland.

Limonia triocellata Osten Sacken

Fentress County—July 3 to August 17.

Scarce. From the upland stream-margin thickets, the banks of the talus slope rills, and from the hemlock-rhododendron association of a shaded, upper talus slope.

Limonia tristigma Osten Sacken

Fentress County—June 24.

A single male from the steep, laurel-rhododendron-maple grown bank of a brook at the bottom of Buffalo Cove.

Adelphomyia pleuralis Dietz

Fentress County—June 13 to July 19.

Locally abundant about wet, rich earth banks in the hemlock-rhododendron association and along the shaded banks of the upper talus slope brooks. The immature stages were not found but are almost certainly spent in the wet, rich soil. I have taken adults of *A. cayuga* Alexander from very similar situations in Michigan and found the immature stages in the organic soil of such habitats.

Tricyphona inconstans Osten Sacken

Fentress County—June 18 to August 11.

Common in moist shaded situations that included seepage areas, brooks, or spring rills. The immature stages are spent in saturated silt where there is some flow of the soil water. They are apparently absent where the soil water is stagnant or attains a high temperature.

Rhaphidolabis forceps Alexander

Fentress County—June 10 to August 8.

Numerous along the shaded brooks of the upper talus slopes and in a narrow gorge through the rim rock into Buffalo Cove. Also taken from the rhododendron thickets at the bottom of the deep gorge below Northrup Falls. The determination is due to Dr. Alexander.

Dicranota notabilis Alexander

Fentress County (type locality)—June 21.

A single female was swept from the ferns and meadow-rue that grew at the base of a shaded wet cliff in Buffalo Cove.

Ula elegans Osten Sacken

Fentress County—June 20 and August 11.

Two specimens: one from the hemlock-rhododendron asso-

ciation, the other from a deep mesophytic woods of the lower talus slopes.

Epiphragma fascipennis (Say)

Fentress County—June 7 to 28; Morgan County—June 12; Scott County—May 28.

Numerous in most wooded, wet, or mesophytic situations. Its season was earlier and markedly shorter than that of *E. solatrix,* and this earlier and shorter season for *E. fascipennis* has been noted in other regions where the ranges of the two species overlap: southern Indiana and northern Georgia.

Epiphragma solatrix Osten Sacken

Fentress County—June 11 to July 15; Morgan County—August 5; Scott County—May 29 and August 15.

Common in July and early August. The Fentress County records for June are all for the lower slopes or bottom of Buffalo Cove, but in July it was much more common on the upland. The habitat distribution is quite like that of *E. fascipennis,* and larvae of both species were taken from the same log in a stream-margin thicket of the upland.

Pseudolimnophila australina Alexander

Fentress County—July 2, 11, and 15.

Rare. From an upland woods bog and from a boggy seepage area on the talus slope of the valley of Clear Fork.

Pseudolimnophila contempta (Osten Sacken)

Fentress County—June 10 to September 3; Morgan County—August 5; Scott County—May 28 to July 24.

Common in the stream-margin thickets, swamps, bogs, and marshes; much less common along the courses of brooks through the upland beech-maple woods and down the talus slopes. The larvae of this species and of *E. luteipennis* were frequently abundant in the muddy margins of the rills through the stream-margin thickets.

Pseudolimnophila luteipennis (Osten Sacken)

Fentress County—June 13 to July 21; Scott County—May

30 and August 15; Cumberland County (T. H. Hubbell)—July 7.

Less common than *P. contempta* and more restricted to the upland marshes and less shaded stream-margin thickets.

Pseudolimnophila toxoneura (Osten Sacken)

Fentress County—June 6 to July 2; Scott County—May 28.

Numerous in the stream-margin thickets of the upland and along the shaded talus slope brooks. Also taken from the hemlock-rhododendron association and along some of the brooks through the upland beech-maple woods.

Limnophila (Lasiomastix) macrocera (Say)[15]

Fentress County—June 6 to August 11; Scott County—May 28.

Common in the upland stream-margin thickets and swamps. An occasional specimen was taken from along the wooded upland brooks and from the sphagnum-huckleberry bogs. The immature stages were found in both the coarse sand of the stream-margin thickets and in the fine, saturated silt of the stream margins.

Limnophila (Dicranophragma) fuscovaria Osten Sacken

Fentress County—June 8 to August 11.

Abundant in moist shaded situations of the upland, and common along the talus slope brooks and the base of the rim rock. The larvae live in wet organic mud.

Limnophila (Phylidorea) adustoides Alexander

Fentress County (type locality)—June 6 to 26; Morgan County—June 19; Scott County—May 30.

Numerous in a variety of moist, wooded situations: stream-

[15] All of the specimens collected (about 30) are clearly the northern *L. (M.) macrocera* (Say) and show no approach to the darker coloration of *L. (M.) macrocera suffusa* Alexander, of central and south Georgia and Florida.

margin thickets, swamps, the upland beech-maple woods, and along the talus slope brooks. Both sexes came to light.

Limnophila (Phylidorea) consimilis Dietz

Fentress County—June 25 and July 2.

Two specimens: from an upland swamp and from a shaded upland brook. The identification is due to Dr. Alexander, who recognized the first specimen as *consimilis* and the second as either *consimilis,* or near it.

Limnophila (Phylidorea) lenta Osten Sacken

Fentress County—June 11 to 13.

Several specimens from the course of a shaded, rocky brook of the upper talus slope of Buffalo Cove.

Limnophila (Phylidorea) lutea Doane

Fentress County—June 30.

A single female was swept from the herbage of an upland marsh. I am indebted to Dr. Alexander for verifying this identification.

Limnophila (Phylidorea) nigrogeniculata Alexander

Fentress County (type locality)—June 30 to July 22.

Common about one swampy stream-margin thicket and in a small swamp. A few specimens were taken from other, but similar situations. All were from the upland.

Limnophila (Phylidorea) subsimilis Alexander

Scott County (type locality)—May 29.

A single male swept from the vicinity of a small brook through the mesophytic upland woods.

Limnophila (Ephelia) serotinella Alexander

Fentress County (type locality)—September 3.

Numerous in a low, alder-grown swale of the upland on this date. Numerous teneral specimens were noted. This species is evidently an autumnal form, just appearing on the wing at the time the field work was discontinued.

Limnophila (Ephelia) solstitialis Alexander

Fentress County—June 8 to July 11; Scott County—May 30.

Common. Nearly all were taken from the rills and brooks of the upper talus slopes or from the base of the wet rim rock. An occasional specimen was taken from along the brook courses and stream-margin thickets of the upland. The identification is due to Dr. Alexander, who included a part of the Fentress County specimens as paratypes of the species.

Limnophila areolata Osten Sacken

Fentress County—June 11.

Four specimens from the cool, hemlock-rhododendron association of the upper talus slopes of Buffalo Cove.

Limnophila laricicola Alexander

Fentress County—June 21.

A single male came to a light stationed near a stream-margin thicket and a sphagnum-huckleberry bog.

Limnophila niveitarsis Osten Sacken

Fentress County—June 16.

A single male from the hemlock-rhododendron association, along the course of an upper talus slope brook.

Ulamorpha pilosella Osten Sacken

Fentress County—June 10 to August 11; Scott County—May 29 and 30, and July 24.

Common in the hemlock-rhododendron association at the foot of the rim rock and abundant along the upper talus slope brooks. It is a characteristic species of the rank growths of *Impatiens* that occur on the wet banks of the talus slope brooks. A few specimens were also taken from a patch of *Impatiens* at the edge of an upland swale. The immature stages were taken from the rich, wet soil in which the *Impatiens* grew.

Pilaria imbecilla (Osten Sacken)

Scott County—May 28 to 30.

Numerous in the low, mesophytic woods of the plateau about Oneida. A pair in copulation was taken from the leaf of a low bush beside a small brook.

Pilaria quadrata (Osten Sacken)

Fentress County—June 6 to July 22; Scott County—May 28 and 29.

Numerous in the upland swamps and stream-margin thickets. A few records from the vicinity of brooks in the beech-maple, upland woods and from a spring rill in the river flood-plain.

Pilaria recondita (Osten Sacken)

Fentress County—June 8 to August 12; Scott County—May 28 and 30.

Common in the upland swamps and stream-margin thickets. Less common in the sphagnum-huckleberry swamps and along the banks of wooded brooks.

Pilaria tenuipes (Say)

Fentress County—May 31 to August 11; Scott County—May 29 and 30, and August 15.

Not as common as *recondita* but more widely distributed. Taken from upland swamps, stream-margin thickets, bogs, marshes, and the banks of both open and shaded brooks of the upland and of the talus slopes. The immature stages occur in the fine, saturated silt of the margins of sluggish streams. In some situations this fine silt formed a very thin layer on top of coarser soils, but the larvae were apparently confined to the fine silt.

Atarba picticornis Osten Sacken

Fentress County—June 11 to August 11; Morgan County—June 12 to 19; Scott County—May 29 and 30.

Abundant and widespread. Occurred in all wooded situa-

tions except the pine and black-jack oak associations and the drier portions of the oak-hickory woods. The immature stages occur in wet, rotten, hardwood logs, but the adults range widely. Copulating pairs were taken both at night and in the daytime, always resting on the upper surface of the leaves of tall herbage or low shrubbery. Both sexes came freely to light.

Elephantomyia westwoodi Osten Sacken

Fentress County—June 7 to August 7; Scott County—May 30; Cumberland County (T. H. Hubbell)—July 14.

Frequent in wet wooded situations of the upland, the coves, and the river valley flood plains. Adults were taken swarming in a small open area of a stream-margin thicket on July 22. The swarm consisted of about 20 individuals and was perhaps seven feet above the tops of the grasses, though well below the tops of the surrounding shrubbery. Larvae were taken from among the loose xylem fibers of a water-soaked, rotten log partially submerged in the small brook that flowed through the stream-margin thicket.

Eriocera aurata Doane

Fentress County—July 1 to August 19.

Common in a wide variety of wet situations. The most characteristic habitat was the sphagnum-huckleberry bogs, but it was also common in the more open stream-margin thickets, and along the open, marshy stream banks. A few specimens were also taken about the base of wet rim rock cliffs and from deep, shaded gorges. The immature stages were found in two very different habitats: from the sphagnum-filled pools of the bogs and beneath a mat of saturated mosses at the base of the wet rim rock. No measurements could be taken, but the two situations must have differed considerably in temperature, daily temperature range, and in H-ion concentration.

Adults were noted swarming just beyond the spray of a waterfall, at the bottom of a deep, shaded gorge. The swarm

consisted of but few individuals, but it was maintained for some time. What was taken for perhaps a primitive swarming was frequently observed in the sphagnum-huckleberry bogs. Three or four males would buzz irregularly just above the tips of the fern clumps for two or three minutes and would then disperse, to settle down separately upon the ferns. One small group was seen to originate when a single flying male, probably searching for females, bumped into a resting male. The second fly was aroused and the two buzzed and tumbled about each other, among the tips of the herbage and finally flushed two other males, who joined the tumbling flight.

Erioptera brachycera Osten Sacken

Fentress County—June 28.

Eight males were netted as they flew close to the water of the small pools of a talus slope brook. The flies were traversing considerable lengths of the brook, passing quickly over the riffles and beating up and down each pool several times, before passing on to the next pool. The flight is very swift for a crane-fly; and one individual was seen to twice avoid the darts of a large dragon-fly that was patrolling the brook. A female was swept from the overhanging shrubbery.

Eriocera cinerea Alexander

Fentress County—June 13, 14, and 15.

On these dates *Eriocera cinerea* was found swarming at dusk, high above the largest of the upland brooks. The swarms were small and diffuse and moved up and down the brook at a height of about 30 feet. Occasional stragglers could be netted by standing on the side rails of a bridge. One female was taken at a lighted sheet, set up near the creek, and another was swept from the overhanging bushes.

Eriocera fuliginosa Osten Sacken

Fentress County—June 19; Morgan County—June 12.

All were taken from the valley of Clear Fork: either swept from the willows of the river bank, or netted at dusk, from

large swarms that were usually about six feet above the river and close to the overhanging trees.

Eriocera fultonensis Alexander

Morgan County—June 12.

Taken at dusk, in the same swarms with *E. fuliginosa*. A male was also taken at light.

Penthoptera albitarsis Osten Sacken

Fentress County—June 13 to September 3.

Abundant in the swamps and common in the stream-margin thickets, along wooded brooks, in bogs, and along the base of the wet, shaded rim rock. Larvae were taken from the mud of the swamps and from the margin of a bog. A single larva was also taken from the wet earth of a fissure in the lower rim rock. Both sexes came freely to light.

Gonomyia (Lipophleps) manca Osten Sacken

Fentress County—June 6 to August 13; Morgan County—June 12; Scott County—May 28 to July 18.

Common in the vicinity of brooks, springs, and seepage areas of all parts of the region. Often abundant in the stream-margin thickets. Came freely to light.

Gonomyia (Gonomyia) cognatella Osten Sacken

Cumberland County (T. H. Hubbell)—July 12.

Six specimens from the banks of a brook in the bottom of Grassy Cove.

Gonomyia (Gonomyia) florens Alexander

Fentress County—June 28.

A single male swept from the herbage of a cool, shaded, upper talus slope brook.

Gonomyia (Gonomyia) subcinerea Osten Sacken

Fentress County—June 6 to August 9; Morgan County—June 12; Scott County—May 28 and 29.

Common about all of the creeks and brooks, and taken from most of the bogs, marshes, and swamps. Less common about the foot of the wet rim rock. Both sexes came freely to light.

Gonomyia (Gonomyia) sulphurella Osten Sacken

Fentress County—June 8 to August 12; Morgan County—June 12; Scott County—May 29 and August 18; Cumberland County (T. H. Hubbell)—July 12.

Abundant in the vicinity of the upland streams and in the vicinity of river and creek flood plains and banks. Rare along the talus slope brooks. The larvae occur in saturated earth that ranges from coarse sand to fine silt, but are much more frequent and abundant in distinctly sandy situations. They were often found in the wet sand bars of the small streams.

Gnophomyia luctuosa Osten Sacken

Fentress County—June 11 to July 21; Scott County—May 29; Cumberland County (T. H. Hubbell)—July 11.

Numerous. Taken from the trunk of a sweet gum at the edge of a swamp, from the trunk of a beach in the upland woods, and in large numbers from the trunk and vicinity of a large oak that grew near the edge of the plateau at Buffalo Cove. Others were swept from the upland and talus slope woods. The immature stages have since been found to occur in the rotting heart wood of cavities in living trees.

Gnophomyia tristissima Osten Sacken

Fentress County—June 25 to July 3; Scott County—May 29; Cumberland County (T. H. Hubbell)—July 12.

Scarce. All records are from the more moist upland woods. The immature stages are spent beneath the loose bark or in the wood of moist, rotting hardwood logs.

Teucholabis complexa Osten Sacken

Fentress County—June 7 to July 24; Morgan County—June 12 and 19; Scott County—May 29.

Abundant in all moist, wooded situations. The immature stages were present in a large percent. of the wet, or very

moist, decaying logs of the region and formed one of the most characteristic inhabitants of the superficial wood of such logs. Both sexes came to light in large numbers and appeared to range widely at night. Both copulation and oviposition were noted at night. *Teucholabis complexa immaculata* Alexander was common, forming about a third of all the specimens observed. No difference in adult habitat or season could be discerned.

Lipsothrix sylvia (Alexander)

Fentress County—June 10 to 28.

Numerous along the shaded, rocky brooks of the higher talus slopes of Buffalo Cove and Clear Fork. The most frequent habitat was the herbage overhanging the small waterfalls and rapids.

This species was originally described as a *Limnophila* but has recently been placed in the genus *Lipsothrix* Loew by Dr. Alexander (letter of May 9, 1928).

Erioptera (Erioptera) chlorophylla Osten Sacken

Fentress County—June 18 to July 21; Cumberland County (T. H. Hubbell)—July 12.

Numerous in the more swampy stream-margin thickets and in the sphagnum-huckleberry bogs. An occasional specimen was taken from the cleared marshes. Both sexes came to light.

Erioptera (Erioptera) chlorophylloides Alexander

Fentress County—June 7 to 30.

Less numerous than *E. chlorophylla*. Occurred in the same stream-margin thickets as *E. chlorophylla* and also in the more sandy type. Did not occur in the bogs or marshes.

Erioptera (Erioptera) chrysocomoides Alexander

Fentress County (type locality)—June 6 to August 11; Scott County—May 29.

Abundant in the stream-margin thickets and common in

cleared areas along brooks through the upland woods. The immature stages occurred in the coarse wet sand and sandy silt along the rills through the thickets.

Erioptera (Erioptera) megopthalma Alexander

Fentress County—June 7.

A single male was taken at light, on the upland.

Erioptera (Erioptera) septemtrionis Osten Sacken

Fentress County—June 6 to August 10; Morgan County—June 12; Scott County—May 30; Cumberland County (T. H. Hubbell)—July 12 and 14.

Frequent and numerous but not common in any one habitat. Taken in the vicinity of both upland and talus slope streams, and came to light in considerable numbers.

Erioptera (Erioptera) vespertina Osten Sacken

Fentress County—June 6 to July 22; Morgan County—June 12.

Numerous about the upland stream-margin thickets, swamps, and marshes. Also taken from a sphagnum-huckleberry bog and (at light) from the river flood plain. The larvae occur in saturated, organic soils, and particularly in the semi-fluid black silt of the margins of small sluggish streams.

Erioptera (Mesocyphona) caloptera Osten Sacken

Fentress County—June 6 to August 12; Scott County—May 28 to 30, and July 18; Cumberland County (T. H. Hubbell)—July 10.

Abundant in the vicinity of all upland streams, marshes, and bogs. Frequent but less common about the rills and seepage areas of the talus slopes and about river banks. The immature stages occur in saturated earth that varies from fine organic silt to sandy silt, but in the latter case the larvae are usually found in a thin surface layer of finer material. Both sexes came freely to light.

Erioptera (Mesocyphona) needhami Alexander

Fentress County—June 16 to August 10.

Rare in June, common in late July and early August. Although the habitat distribution of this species overlapped that of *E. caloptera,* it was rarely taken from about marshes or bogs and appeared much more characteristic of the talus slope rills and the seepage areas at the foot of the rim rock. Larvae of this species have been found (in Florida) in saturated soil that is distinctly more sandy than the typical habitat of *E. caloptera.* Both sexes came to light.

Erioptera (Mesocyphona) parva Osten Sacken

Fentress County—June 6 to August 9; Scott County—May 29 and 30, and August 15; Cumberland County (T. H. Hubbell)—July 12.

Frequent, but never abundant, in nearly all wet situations except the bogs and regions of dense shade.

Erioptera (Hoplolabis) armata Osten Sacken

Fentress County—June 14 to August 7.

Locally numerous along some of the upland brooks and on the shaded banks of Clear Fork. The immature stages have been taken (in Iowa and in Georgia) from the wet earth of the vertical banks of small brooks.

Erioptera (Ilisia) graphica Osten Sacken

Fentress County—June 18 to July 16; Cumberland County (T. H. Hubbell)—July 12.

Taken in moderate numbers from the grassy banks and the vicinity of several of the upland brooks.

Ormosia adirondacensis Alexander

Fentress County—June 10 and 11.

About a dozen specimens were taken while resting on or hovering about the lower trunks of large trees in the hemlock-rhododendron association of the upper slopes of Buffalo Cove. I am indebted to Dr. Alexander for the identification of these specimens.

Molophilus auricomus Alexander

Fentress County (type locality)—June 6 to July 22.

An abundant species in the vicinity of small shaded streams and seepage areas; less common about the unshaded streams and marshes. Hundreds of individuals could be swept from the herbage and shrubbery of the talus slope brooks throughout June, but no males were taken until June 20. In July the males became very common. Both sexes came to light.

Molophilus cramptoni Alexander

Fentress County—June 21 and 28.

A few males and females were swept from the herbage of the hemlock-rhododendron association and the banks of shaded brooks of the upper talus slopes.

Molophilus cumberlandensis Alexander

Fentress County (type locality)—June 24 to September 3.

Abundant along the base of the wet rim rock and about the brooks of the upper talus slopes; common in the stream-margin thickets and swamps of the upland.

Molophilus floridensis Alexander

Fentress County—June 6 to July 22.

Common in the stream-margin thickets and in the vicinity of the upland brooks. A few records from along the talus slope brooks.

Molophilus forcipula Osten Sacken

Fentress County—June 6 to September 3; Scott County—May 28 to 30.

Abundant about all upland streams, swamps, and marshes. Came to light in large numbers.

Molophilus pubipennis Osten Sacken

Fentress County—August 13; Cumberland County (T. H. Hubbell)—July 12.

I did not find a single specimen of this species in the sum-

mer of 1924, but Professor Hubbell took a male and several females at Grassy Cove, and in 1923, on the single day that I collected in this region, I took one male from the upper slopes of Buffalo Cove.

Dasymolophilus niphadias (Alexander)

Fentress County—June 20 and July 2.

Numerous on these dates, about a tiny spring rill on the talus slopes of the valley of Clear Fork.

Helobia hybrida (Meigen)

Fentress County—June 6 to July 7; Scott County—May 29.

Rare. The few records are from the upland stream-margin thickets and the banks of wooded brooks. Probably this species was much more common in the early spring.

Rhabdomastix flava (Alexander)

Fentress County—June 16 to July 16; Scott County—May 29.

Common in the more sandy of the stream-margin thickets and about the banks of several of the shaded upland brooks. A single record from the deeply shaded gorge below Northrup Falls.

Cryptolabis paradoxa Osten Sacken

Fentress County—June 18 to July 11; Morgan County—June 19.

Abundant on the wooded banks of Clear Fork and moderately numerous about one of the small upland brooks and a stream-margin thicket. On June 19 and July 2 this species could be swept in unlimited numbers from the thick shrubbery of the river banks as one waded along the margin. Numerous pairs were taken in copulation as they rested on the upper surfaces of the leaves. Both sexes came to light in numbers, when the light was stationed within a hundred yards of their daytime haunts.

PLATE I

FIG. 1. The characteristic, rather open, dry, oak-hickory woods of the upland, Fentress County. This was the habitat of a small but characteristic crane-fly fauna, including: *Tipula umbrosa*, and three species of *Dicranoptycha*, *megaphallus*, *sobrina*, and *winnemana*.

FIG. 2. A portion of the more mesophytic upland woods of Fentress County. Here the trees are larger and more frequent, the shade much deeper and more uniform, and the soil and dead wood distinctly more moist. The photograph was taken from a small clearing that shows in the foreground.

PLATE II

FIG. 3. The interior of an upland stream-margin thicket, Fentress County. In the middle foreground is shown one of the small channels of the braided stream that wanders through the thicket. This type of habitat was frequent on the upland; and some of the thickets were several acres in extent. These stream-margin thickets were the typical habitat of a large number of crane-fly species.

FIG. 4. The merging of a sphagnum-huckleberry bog and an upland swamp, Fentress County. The photograph is taken from the bog, and the foreground shows the open bog with ferns growing from the rounded mounds of sphagnum. The swamp has a thick stand of red-maple, black gum, and alder.

J. Speed Rogers

PLATE III

FIG. 5. A moist, grass and sedge swale in the upland pine woods, Fentress County. The floor of the swale is from two to three feet lower than the floor of the dry pine woods that lie on three sides of it. The low bushes in the foreground and the larger clumps in the middle background are mostly alders. Among the distant alder clumps begins the water course of a small, wet-weather stream. Such swales had a considerable crane-fly fauna and were the typical habitat of *Nephrotoma xanthostigma*, *Tipula manhatta*, and *Limnophila serotinella*.

FIG. 6. Looking across an arm of Buffalo Cove from a point part way down the rim rock. The characteristic rim rock cliff is well shown in the middle distance. About the upper two-thirds of the talus slope is shown. Clearings were rare on the talus slope and were of small extent.

PLATE IV

FIG. 7. A brook course, through the rim rock, into Buffalo Cove. The photograph is taken at about the level of the base of the rim rock. The face of the small ledge over which the stream falls and trickles is covered with a thin coat of tightly clinging, saturated mosses and here occurred the immature stages of *Tipula brevifurcata*, *Elliptera illini*, *Dicranomyia simulans*, and an unidentified *Tipula*. Beneath the ledge is a low shallow cavern, on whose dripping ceiling rested numerous individuals of *Dolichopeza americana*, *Oropeza albipes*, *Dicranomyia pubipennis*, and *D. simulans*. Above the ledge is the floor of a small, short canyon, deeply shaded by hemlocks and rhododendron. Here occurred a rich crane-fly fauna and the typical habitat of *Adelphomyia pleuralis* and *Rhaphidolabis forceps*.

FIG. 8. At the foot of the rim rock, Northrup Falls Canyon, Fentress County. This spot, with its overhanging cliffs, is typical of the shaded, wet cliffs that were common throughout the region. The darker cliffs at the right are wet and covered with thick mosses and at their foot are small spring areas with black boggy soil. Such spots had a rich and typical crane-fly fauna. Many of the species spent their immature stages in the wet mosses on the cliffs, others in the cool, wet soil at its foot.

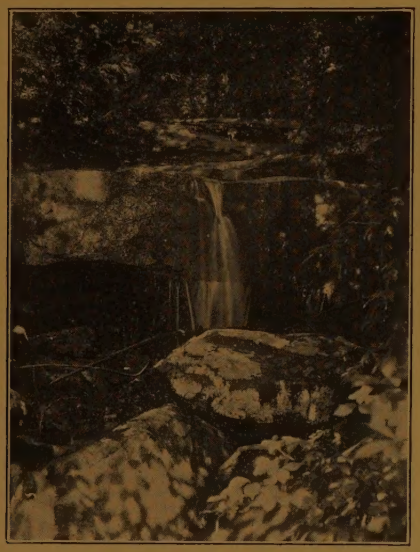

PLATE V

FIG. 9. Talus slopes of the valley of Clear Fork, Morgan County. Beneath the outcropping strata is shown one of the low, shallow caverns, "rock houses," that are common in all the coves and stream valleys of the region. Above the rocks are the dry, open woods of the middle talus slope. The "rock houses" were damp and cool, and from this one were taken, among other species, *Tipula apicalis, T. ignobilis, T. oropezoides, T. hermannia, Dolichopeza americana, Oropeza albipes, O. obscura,* and *Dicranomyia badia. Tipula algonquin* occurred only in "rock houses" whose open sides were deeply and permanently shaded.
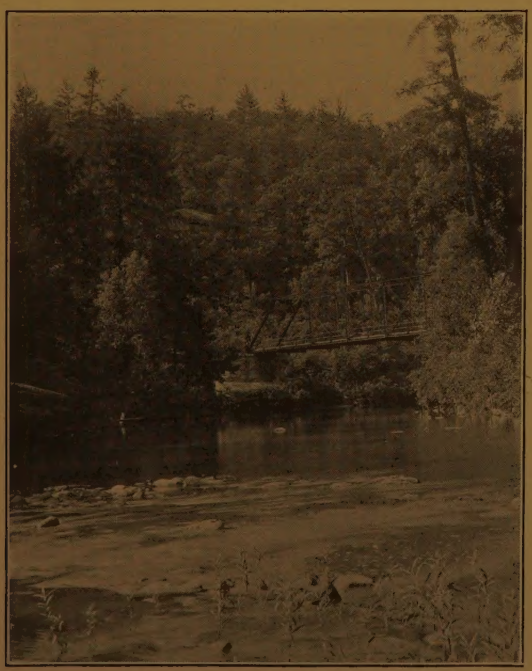
FIG. 10. Clear Fork, at Peter's Ford, between Fentress and Morgan Counties. On the rock of the riffle, shown in the foreground, *Antocha* sp. was found ovipositing at night in tremendous numbers. From the bushes overhanging the stream's edge were taken, *Antocha* sp., *Eriocera fuliginosa, E. fultonensis,* and *Cryptolabis paradoxa.* Both species of *Eriocera* were also taken while swarming over the water, at this point. The plants growing from the water in the immediate foreground are a scant stand of *Dianthera.* The more luxuriant growths of this plant formed the typical habitat of a small group of crane-fly species, especially *Tipula concava.*